NORMAL I/O COMMAND

```
N
SCAL "N
SCAL 4EH
RST 18H:DEFB 4EH
```

The N command sets the input and output tables to 'normal'. The output table is simply CRT so that output is directed only to the video display. The input table is RKBD (KBD in NAS-SYS1) and SRLIN so that input is taken either from the keyboard or the serial input port.

See also commands U and X which change the input/output tables.

OUTPUT COMMAND

```
O xx yy
```

The output command sends data to an output port. Output port xx is loaded with data yy.
eg. O 4 6F sends byte 6fH to port 04H.

Note that if the port is physically a PIO, the control register of the PIO must first be loaded with the appropriate code to program it as an output port.
See also the Q command.

PROGRAM REGISTER DISPLAY
(NAS-SYS 3 only)

```
P
SCAL "P
SCAL 50H
RST 18H:DEFB 50H
DF 50
```

The Program registers display command displays the contents of the Z80 cpu registers as stored in the register save area of the workspace.
The Z80 registers are automatically saved in the register save area whenever a breakpoint is reached, or after each instruction step when using the S command (which, incidentally,invokes this command to produce the display), or when RST 20H (E7H) is executed.
For the format of the display refer to the S command.

QUERY COMMAND Q xx

The Query command inputs data from an input port and displays it in hexadecimal.
eg. Q 4 inputs data from port 04H and displays it.
Note that if the port is physically a PIO, the control register of the PIO must first be loaded with the appropriate code to make it an input port.
See also the O command.

READ CASSETTE TAPE COMMAND R xxxx
SCAL "R
SCAL 52H
RST 18H:DEFB 52H
DF 52H

The Read cassette tape command reads a tape that was written using the W (Write cassette) command. Data is normally loaded into the same memory locations from which it was written. However, NAS-SYS 3 allows a displacement, xxxx, to be added to the addresses of the data so that if memory locations 1000H to 1400H were written to the tape, command R 3000 loadds the data into memory locations 4000H to 4400H. The tape may also be read into lower addresses, eg if data were written from locations 4000H onwards, command R F000 will load the data into locations 3000H onwards since 4000H + F000H = (1)3000H.

At the start of the command execution, the tape led is switched on. Input from the serial input port or the keyboard is read and discarded until four start of block characters (FFH) are read (or four ESCape characters-see below).
The four start of block characters indicate the start of the next block of data on the tape. If the checksum for the header data is incorrect, a question mark is displayed and the data following is ignored. Otherwise, as the block is read the screen displays:

SSSS BBLL
where SSSS is the start address of the block
BB is the block number,decrementing.
LL is the number of bytes in the block, normally 00 (=256).

If the data checksum is correct, a full stop is displayed; otherwise, a question mark is displayed indicating that data in the block just loaded is corrupt. The tape may be rewound for a length of tape greater than one block and then replayed.
At the endo of the command the tape led is turned off.

Because both the cassette input and the keyboard provide input data, no keyboard keys should normally be pressed during a tape read: doing so will produce errors in the loaded data which will be indicated by a question mark.

If the ESCape key is pressed four times after the end of one block and before the start of the next, the Read command will be aborted.

SINGLE STEP COMMAND S xxxx

The Single Step command allows a program to be stepped through one program instruction at a time.

S xxxx executes the instruction beginning at memory location xxxx.At the end of the instruction (which may be one to four bytes long) the register contents are stored in the register save area of the workspace and displayed. The display format is given below.
Pressing Enter will cause the next program instruction to be executed and the registers again displayed. If a repeating keyboard is used (as in NAS-SYS 3 or a patched NAS-SYS 1) the Enter key may be held down to single step at high speed.

If the S command is entered without xxxx being specified, the command uses the saved program counter stored in the register save area of the workspace. This allows the user to single step following a breakpoint simply by typing S.

Program Debugging
The S command together with the B command provide a most useful program debugging facility. Often a breakpoint will be set in the program being debugged and the program executed from the start, using the E command. At the breakpoint the registers are examined. Any of these registers may be changed by using the M command to modify the register save area of the workspace, and then the next program instruction executed by typing S. If no registers are changed the next instruction may be executed simply by pressing Enter. Alternatively, the remainder of the program may be executed by typing E.

The workspace locations which store the saved registers are:

0C68	Register A
0C67	Register F
0C62	Register B
0C61	Register C
0C64	Register D
0C63	Register E
0C66	Register H
0C65	Register L
0C6A	Program Counter,high byte
0C69	Program Counter,low byte
0C6C	Stack Pointer,high byte
0C6B	Stack pointer,low byte

Display Format.NAS-SYS 3

```
-SP-  nnvv  -PC-  nnvv  -AF-  nnvv  -HL-  nnvv
-DE-  nnvv  -BC-  nnvv  I  -IX-  -IY-  Flags
```

The two bytes displayed after the first six registers or register pairs are the contents of the location pointed to by that register pair.
eg. A display beginning :-

```
OFFD 21A7  22B6  C8F5  0380  2790 .....
```

shows that the SP is OFFD,
and the contents of location OFFD is A7H
and the contents of location OFFE is 21H,

the PC is 22B6,
and the contents of location 22B6 is F5H
and the contents of location 22B7 is C8H,

the A register is 03H,
the F register is 80H,
and the contents of location 0380 is 90H
and the contents of location 0381 is 27H.

The Flags part of the display is a parsed version of the F register; in the example shown, Flags will show S, indicating that the Sign flag is set (F register is 80H).

Display Format. NAS-SYS 1

```
-SP-  -PC-  -AF-  -HL-  -DE-  -BC-  I  -IX-  -IY-  Flags
```

Note that in both displays, -PC- shows the address of the next instruction to be executed.

TABULATE COMMAND
(NAS-SYS 3)

```
T xxxx yyyy zzzz vv hhaa
SCAL "T
SCAL 54H
RST 18H:DEFB 54H
DF 54
```

The Tabulate command displays the contents of a block of memory locations.

xxxx — is the first location displayed.

yyyy — is one more than the last location displayed

zzzz — determines the number of lines displayed at a time; press any key to display the next group of lines; press ESC to abort the command. If zzzz is zero, all the locations will be tabulated without pause.

vv — determines the number of bytes on each line. 8+vv bytes will be displayed. eg. if vv=04H there will be twelve bytes per line (04H + 08H = 0CH); if vv=FCH there will be four bytes per line (FCH + 08H = 04H)

hh — If hh is non-zero, the hexadecimal tabulation is suppressed.

aa — If aa is non-zero, the ASCII tabulation is supressed.

Each display line begins with a memory address followed by the contents of that location (in hexadecimal) followed by the contents of several succeeding locations. At the right-hand part of the display line, the same data is displayed by showing the ASCII characters corresponding to the data bytes. Hexadecimal values 00-1F, 7F-9F, and FF are shown as a full stop.

The Tabulate command is the only one using more than three parameters.

TABULATE COMMAND
(NAS-SYS 1)

```
T xxxx yyyy zzzz
SCAL "T
SCAL 54H
RST 18H: DEFB 54H
DF 54
```

This is similar to the Tabulate command in NAS-SYS 3: however, only the first three arguments of that command are utilised. The display does not include the ASCII characters corresponding to the data bytes. Instead, at the end of each line of eight data bytes, a checksum is output. This is backspaced over on the display so appears only momentarily. By activating the X command, the contents of a block of memory may be dumped onto a serial output device, such as a paper tape punch, and then loaded back into the computer using the L (Load) command.

USER I/O COMMAND

```
U
SCAL "U
SCAL 55H
RST 18H:DEFB 55H
```

The U command brings user-written input and output routines into the input/output tables. See Chapter 1.4.

The output table is set to include UOUT and CRT so that output is directed to the users output routine as well as to the video display.

The input table is set to include UIN, RKBD (or KBD in NAS-SYS 1), and SRLIN, so that input is taken from the users input routine, the keyboard, or the serial input port.

The start address of the users output routine must be placed in